VISUAL ANALYSIS OF LITERATURE ON CHINA'S PARTICIPATION IN INTERNATIONAL HEALTH COOPERATION BASED ON CITESPACE

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Abstract: Objective: To analyze the research hotspots and evolution trends in China's participation in international health cooperation through bibliometric methods, with the aim of providing references for improving research in this field. Method: Data was extracted from the VIP Chinese Journal Service Platform. The retrieval period was from 1998 to 2024. CiteSpace software was used to analyze the selected literature to form a visual scientific network map. Result: Research on China's participation in the field of international health cooperation has increased significantly since 2019. The author collaboration network has taken shape initially. The research mainly focuses on "public health", "international cooperation", "global governance" and "COVID-19 pandemic", etc. Conclusion: International cooperation, global health governance and public health have become the key points of continuous attention for China's participation in international health cooperation research. In the future, theoretical discussions should be further deepened, multi-disciplinary integration should be strengthened, new issues in global health governance should be focused on, and innovation in international cooperation mechanisms should be promoted to achieve a fairer, more effective and sustainable global health governance system.
Keywords: China's participation in international health cooperation; Global health governance; CiteSpace

1 INTRODUCTION

In the tide of globalization, international health cooperation (IHC), as a global governance mechanism, is increasingly highlighting its importance in the global health cause [1]. Meanwhile, the Chinese government has also made a commitment to developing countries, aiming to assist them in implementing 100 "Maternal and Child Health Projects" and building 100 hospitals and clinics in the health sector, etc [2]. A series of measures and policies of the Chinese government have increasingly highlighted its key position in international health cooperation. CiteSpace software is a visualization tool developed by Professor Chen Chaomei's team, capable of analyzing the development trends of various research fields. This software visualizes data samples based on co-citation analysis and pathfinding network algorithms, and can present the relationships between literature in the form of a scientific knowledge graph. It can not only clarify the research trajectory, current situation and hotspots in a certain field, but also reveal the future development direction of this field [3]. This study adopted bibliometric methods and utilized CiteSpace to conduct a visual analysis of the relevant research on China's participation in international health cooperation. The analysis was carried out from different perspectives such as the number of published papers, core authors, and keywords of China's participation in international health cooperation research, to understand the research hotspots and evolution trends in this field of China's participation in international health cooperation. With the aim of providing references for improving research in related fields of international health cooperation.

2 MATERIALS AND METHODS

2.1 Data Sources and Screening

The corresponding search was conducted using the VIP Chinese Journal Service Platform as the data source, with the search strategy as the theme = Public Health * (International Health Cooperation/Global Health Governance). The search period was from 1998 to 2025. All journals were selected for the journal scope. Relevant literature on international health cooperation was searched. Eventually, 435 related literatures were retrieved.

2.2 Data Analysis

Import the retrieved literature into the NoteExpress software. After checking for plagiarism, manually screen each item one by one to eliminate the following literature: 1) Literature irrelevant to the research topic; 2) Incomplete bibliographic records and duplicate references; 3) Conference reports, newspapers, etc. 4) Policy Interpretation. A total of 259 literatures were finally included. The included literature was exported in Refworks format and analyzed and processed accordingly using CiteSpace software. Use Excel to conduct the annual article Posting statistics, and set the time partition length to 2. The CiteSpace software was used to conduct a visual analysis of the authors, institutions and keywords of the included literature. The Time Slicing was from January 1998 to December 2024, and the Years Slice

was one year. When drawing the map, Adjust the parameter k value of g-index according to the number of nodes in the graph, and all other Settings are default parameters.

3 RESULTS

3.1 Statistics on the Number of Published Articles

The time span for counting the number of published articles is from 1998 to 2024. As 2025 is not a complete year, it was not included. From 1998 to 2019, there were few domestic studies on international health cooperation, and the number of published papers also fluctuated. However, from 2019 to 2020, the number of research papers published saw an explosive growth, reaching a peak of 78 in 2020. This was closely related to the outbreak of the COVID-19 pandemic worldwide at the end of 2019, which promoted domestic research on China's participation in international health cooperation. As the global COVID-19 pandemic fluctuated and was brought under certain control, related research began to show a downward trend in 2021. See Figure 1 for details.
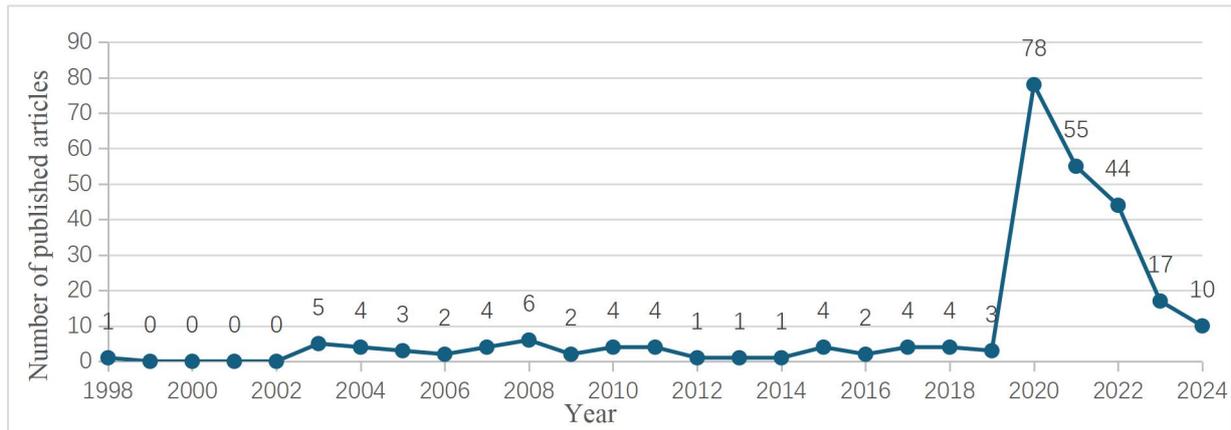

Figure 1 The Number of Domestic Research Papers Related to International Health Cooperation Published from 1998 to 2024

3.2 Distribution of Cooperation among Authors of the Published Articles

A statistical analysis of the authors who have published academic research papers related to international health cooperation in China over the past 30 years reveals that a total of 226 authors were involved in this study. In terms of the number of papers published by the authors, the top five authors in terms of the number of papers published are: Jin Jiyong (6 articles), Zou Yunduo (2 articles), Zhao Changfeng (2 articles), Zheng Zhou (2 articles), and Xu Ming (2 articles) formed a graph containing 215 nodes, 172 connections, and a network density of 0.0075. Each node represents one author, and the larger the node radius, the more published articles there are. The lines connecting nodes represent the cooperative relationship, and the color of the lines indicates the time when the cooperation first occurred. The author collaboration network represented by Zhang Lixing is relatively large in scale, followed by those represented by Li Wei, Chen Minjian, Xie Yi and Xu Ming. However, there is less collaboration among the rest of the authors. See Figure 2 for details.
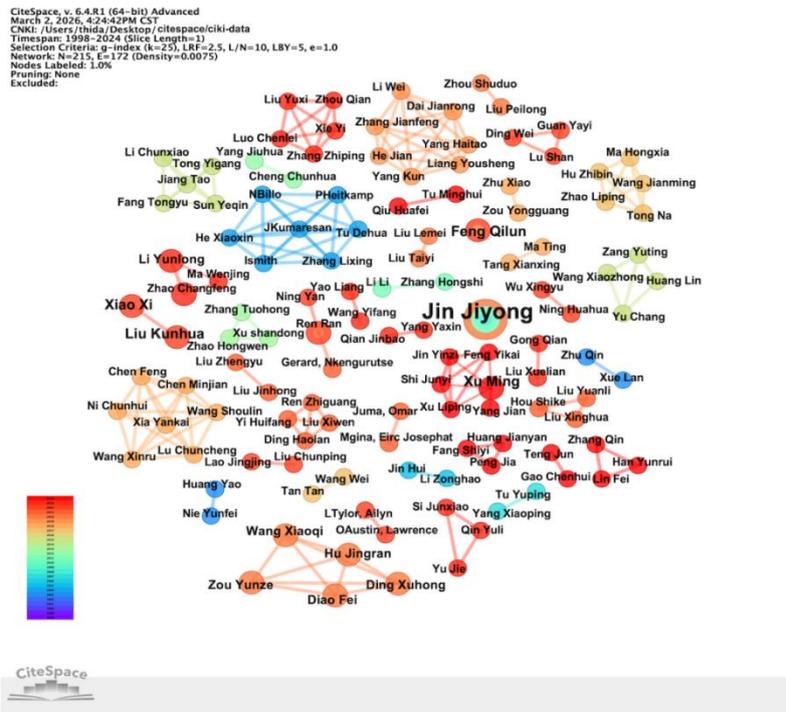
Figure 2 Author Cooperation Map of China's Participation in the Field of International Health Cooperation

3.3 Keyword Analysis

3.3.1 Keyword co-occurrence

A visual analysis of the keywords was conducted, forming a graph containing 254 nodes, 542 connections, and a network density of 0.0169. Keywords with a occurrence frequency of more than 4 times and their intermediate centrality were identified.   Mediation centrality, which refers to the probability of a certain node falling into the shortest path between any two nodes, can be used to describe the importance of a certain node in a network. In CiteSpace, nodes with mediation centrality greater than 0.1 can be called critical nodes [4]. In China's participation in international health cooperation research, the mediating centrality of "public health", "international cooperation", "epidemic", "COVID-19", "United Nations", "global governance", and "infectious diseases" is greater than 0.1, making them important fields for China's related research on international health cooperation. Please refer to Table 1 and Figure 3 for details.

Table 1 High-frequency Words and Their Mediating Centrality in Literature Related to China's Participation in International Health Cooperation from 1996 to 2023 (Frequency >2)

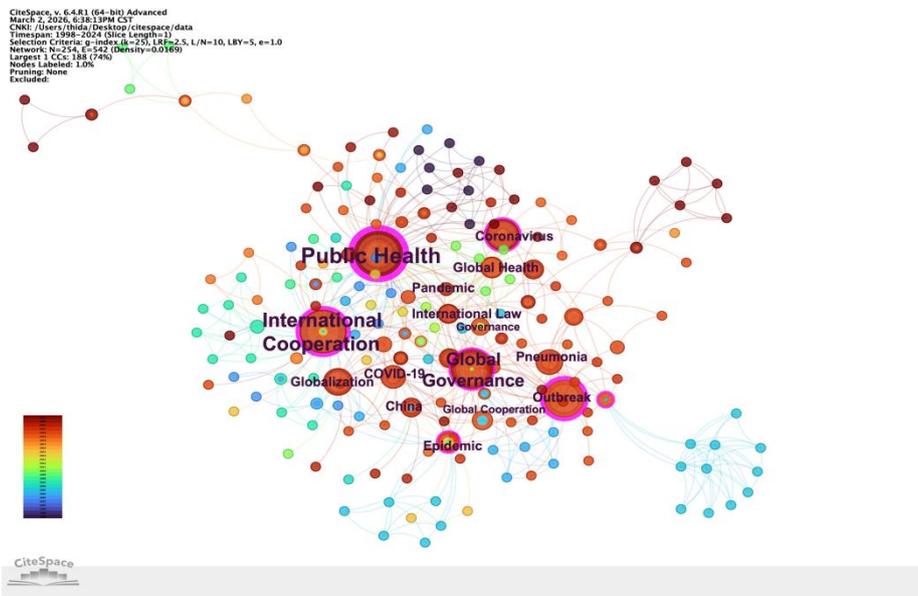| Rank	Keywords	Frequency	Centrality
1	Public Health	46	0.48
2	International Cooperation	37	0.30
3	Pandemic	17	0.24
4	COVID-19	13	0.19
5	United Nations	3	0.13
6	Global Governance	19	0.12
7	Communicable Diseases	8	0.11

Figure 3 Keywords Co-occurrence Map of Literature on China's Participation in International Health Cooperation (1996–2024)

3.3.2 Keyword clustering

In the clustering map, if the modularity Q-value is greater than 0.3, the modular structure of the clustering is considered significant; if the mean silhouette S-value is greater than 0.5, the clustering results are deemed reasonable, and if the S-value exceeds 0.7, the results are considered convincing [4]. In the keyword clustering analysis of the literature on China's participation in international health cooperation, the modularity Q-value is 0.6972 (> 0.3), indicating that the modular structure of the clustering is significant, and the mean silhouette S-value is 0.8694 (> 0.7), suggesting that the clustering results are reliable. A total of 11 clusters are formed in the map. The smaller the cluster number, the larger the cluster scale. Based on the analysis of the keywords in each cluster using the LLR algorithm, the cluster labels are: epidemic, international cooperation, public health, cooperation, globalization, global health, disaster medicine, infectious diseases, international law, necessity, and pandemic. The analysis reveals that current research hotspots on China's participation in international health cooperation primarily focus on major public health emergency response, global health governance system development, public health systems and legal frameworks, and the critical role of cooperation in addressing global health challenges. See Figure 4 for details.
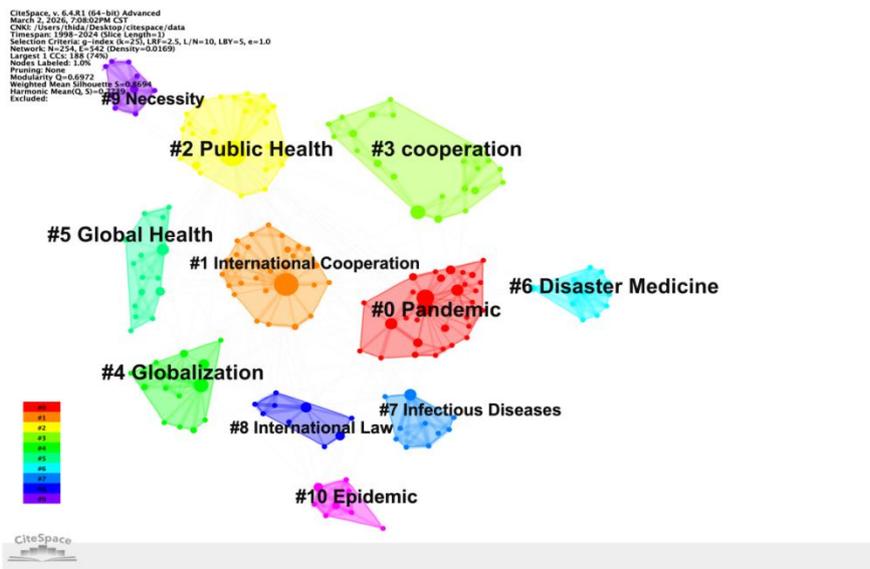

Figure 4 Keywords Clustering Map of Literature on China's Participation in International Health Cooperation (1996–2024)

3.3.3 Research hotspots of keywords

Expanding the keyword clusters along a timeline yields the keyword timeline map. In the map, the years increase from left to right, with each time zone spanning five years. The position of a node corresponds to the year in which the keyword first appeared, providing a more intuitive view of the evolution and shifting research hotspots in studies on China's participation in international health cooperation. See Figure 5 for details Figure 5 for details.
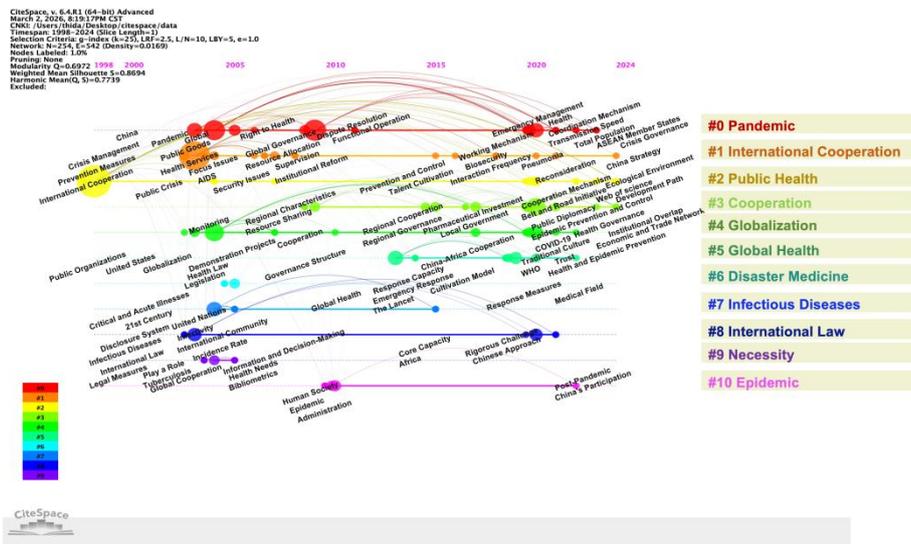
Figure 5 Keywords Timeline Map of Literature on China's Participation in International Health Cooperation
(1996–2024)

Keyword Burst Detection refers to a significant increase in the frequency of a keyword over a short period, which helps identify research frontiers in a specific field [5]. Using Burstness analysis, a burst term list was generated, where "Begin" and "End" represent the start and end years of the burst, respectively; "Year" indicates the first year the keyword appeared; and "Strength" denotes the burst intensity of the term—the higher the value, the greater the influence of the term. The higher the burst strength, the more it represents a research frontier. In the burst visualization, red segments indicate the time periods during which the burst terms were active [6]. A total of the top 20 burst terms were identified, among which keywords with relatively high burst strength include pandemic (4.52), pneumonia (2.41), and COVID-19 (2.1), indicating that these three research directions have yielded a substantial number of research achievement over a short period and represent current research hotspots. See Figure 6 for details.

Figure 6 Keyword Burst Detection Map of Literature on China's Participation in International Health Cooperation
(1996–2024)

4 DISCUSSION

4.1 Current Status and Core Force Distribution of Domestic Research on China's Participation in International Health Cooperation

The number of disciplinary research papers reflects the development status of a discipline. Over the past 30 years, the volume of domestic research publications on China's participation in international health cooperation has increased significantly since 2019. This trend may be related to the COVID-19 pandemic, as an increasing number of scholars have focused on the role and significance of China's engagement in global public health crises [7]. However, the overall number of publications in this field remains relatively low, possibly due to the selection of only domestic journals. Future research should examine the significance of China's participation in global health governance from an international perspective, integrating diverse insights to generate more academically valuable studies.

An analysis of authors reveals few connections between them, indicating limited collaboration and exchange among researchers [8]. According to Price's Law, the core author identification formula is $M \approx 0.749\sqrt{n_{max}}$, where nmax represents the highest number of publications by a single author in the field [9]. The calculated M≈1.935, meaning that, based on integer rounding, authors with two or more publications in this field can be considered core authors. Statistical results show that there are 17 core authors. This suggests a need to establish broader collaborative networks to expand the core author base in this research field, thereby fostering further development and innovation.

4.2 Analysis of Research Hotspots and Trends in Domestic Studies on China's Participation in International Health Cooperation

4.2.1 Global public health cooperation as a research hotspot in China's international health cooperation studies

High-frequency keywords and keyword clustering reflect research hotspots in a given field [10]. Keyword co-occurrence analysis (Figure 3, Table 1) indicates that a stable and closely connected core research framework has been established in this field. "Public Health" (frequency: 46, centrality: 0.48) and "International Cooperation" (frequency: 37, centrality: 0.30) are the two most central nodes. Their high frequency and betweenness centrality suggest that they serve as the foundation and main theme of research on China's participation in international health cooperation, establishing the fundamental research paradigm—examining cross-border collaboration models from a public security perspective. Additionally, "Global Governance" (frequency: 19, centrality: 0.12) emerges as a significant keyword, marking a shift in research perspective from traditional bilateral or multilateral cooperation toward the construction of institutionalized and standardized global rules and systems, resonating with the concept of a "community with a shared future for mankind."

As global public health issues become increasingly globalized and health disparities between countries widen, the demand for global public health cooperation governance has emerged. However, global public health cooperation is characterized by complex structures, diverse governance actors, significant differences in political landscapes and economic development levels across countries, and the diversity of global public health crises. These factors make it difficult to reach consensus in international health cooperation, affecting the effectiveness of countries' participation in global health governance and posing challenges to China's involvement [11]. At present, global public health cooperation is not only a research hotspot in China's international health cooperation studies but also a vivid manifestation of China's diplomatic strategy and international responsibility. In the future, China should actively play a leading role in international health cooperation, promote the construction of a fairer and more reasonable global health governance system, and contribute more Chinese wisdom to the development of global health. On this basis, efforts should also be made to strengthen the construction and reform of domestic health systems, enhance China's voice and influence in global health governance, and strive towards the goal of building a "global community of health for all."

4.2.2 Major public health emergencies as catalysts for the development of China's participation in international health cooperation

Understanding research frontiers helps researchers grasp the direction of disciplinary development and promotes progress in the field [12]. Keyword analysis reveals that between 2019 and 2023, "pandemic," "pneumonia," and "COVID-19" became the most prominent keywords, indicating a sharp short-term research focus on pandemic response. This event is a direct result of the interaction between specific historical contexts and academic attention, not only leading to an explosion in related research publications but also prompting scholars to conduct in-depth discussions on China's participation in global pandemic response, vaccine cooperation, information sharing, and other specific practices [13].

As the pandemic entered a new phase, frontier research has begun to explore the institutionalization and normalization of emergency cooperation mechanisms formed during the pandemic to address potential future public health crises. This reflects an evolving trend in frontier research from "emergency response" to "long-term mechanism construction." The strong emergence of public health emergencies is not an isolated phenomenon but signifies that research in this field has entered a new stage driven by major real-world crises, centered on China's actions, and oriented toward the reconstruction of the future global health system. It is not only the most active research frontier but also serves as a key hub, testing and deepening traditional core concepts such as "international cooperation," "global governance," and "public health" in new practical contexts, significantly advancing knowledge renewal and paradigm development in the study of China's participation in international health cooperation.

5 PROSPECTS

This study uses CiteSpace to visually analyze the literature on China's participation in international health cooperation. Based on an examination of publication volume, authors, and keywords, it summarizes the research dynamics and hotspots in this field. Based on the findings, the following prospects for future research are proposed:

1) Deepen theoretical research on China's participation in international health cooperation and further explore its multidimensional influencing factors. To deepen this field, it is necessary to further analyze multidimensional influencing factors, including political, economic, cultural, and technological aspects. These factors interact and collectively influence the effectiveness of international health cooperation. Future research should develop comprehensive models to analyze the interaction mechanisms of these factors, providing a theoretical basis for formulating more scientific cooperation strategies. Efforts should also be made to improve the WHO-centered

international cooperation framework, strengthen core capacity building in sovereign states participating in international health cooperation, and establish detailed financing mechanisms to better address potential future public health challenges [14].

2) Strengthen interdisciplinary integration. Given the complexity and dynamic nature of international health cooperation, a single disciplinary perspective is no longer sufficient to meet research needs. Therefore, strengthening interdisciplinary integration—incorporating public health, international politics, economics, sociology, and other disciplines—is particularly important. Such interdisciplinary collaboration can break down disciplinary barriers and promote the integration and interaction of knowledge from different fields. Multidisciplinary teamwork can lead to more comprehensive and in-depth research findings, providing more scientific guidance and support for international health cooperation.

3) Focus on emerging issues in global health governance. As global public health events continue to evolve, new issues emerge constantly [15]. To effectively address these challenges, continuous attention must be given to in-depth research on emerging public health challenges. Future studies should explore how to incorporate climate change factors into global health governance, continuously update prevention and control strategies and technological means, and ensure effective responses to public health emergencies within the framework of international health cooperation.

4) Establish and improve multilateral health cooperation mechanisms. Taking major public health emergency response as a starting point and relying on multilateral health cooperation mechanisms, China should leverage its core strengths to play a guiding role in agenda setting and direction control in discussions, commensurate with its national capacity. China should also capitalize on its advantages in producing and supplying public health emergency products, improve communication and coordination mechanisms with WHO headquarters and regional offices, and provide guiding solutions for building a global community of health for all [16].

5) Strengthen data-driven and intelligent decision-making. The rapid development of big data and artificial intelligence technologies provides new tools and means for international health cooperation. By enhancing data collection, integration, and analysis capabilities, researchers can more accurately grasp dynamic changes and trends in public health events. A global public health data-sharing platform could be established to facilitate data interconnectivity among countries. Machine learning and other technologies can be used to uncover potential patterns and models in data, and intelligent early warning systems can be developed to detect and respond to potential risks in a timely manner.

6) Promote innovation in international cooperation mechanisms. To achieve this goal, more diversified international cooperation models can be explored, such as public-private partnerships (PPPs) and international joint laboratories [17]. Public-private partnerships can effectively integrate resources from governments, enterprises, and social capital to jointly promote the implementation of health projects. International joint laboratories can strengthen collaboration between research institutions and academic organizations, facilitating technology transfer and knowledge sharing [18]. In addition, platforms such as international organizations and multilateral development banks can be leveraged to promote reform and improvement of the global health governance system. Through the practice of these innovative cooperation models, the connotation and forms of international health cooperation can be continuously enriched, enhancing its capacity and effectiveness in addressing global public health challenges.

6 CONCLUSION

This study utilizes CiteSpace to conduct a bibliometric analysis of literature on China's participation in international health cooperation from 1998 to 2024, based on the VIP Chinese Journal Service Platform. The findings indicate a marked increase in research output since 2019, driven largely by the COVID-19 pandemic. Keyword co-occurrence and clustering analyses identify public health, international cooperation, global governance, as central themes, with modularity and silhouette values confirming the robustness of the clustering structure. The author collaboration network remains nascent, with limited interconnectivity among researchers, suggesting the need for expanded academic networks. Future research should deepen theoretical frameworks, enhance interdisciplinary integration, address emerging global health governance challenges, and promote innovation in multilateral cooperation mechanisms. These efforts are essential for advancing China's role in building a fairer and more sustainable global health governance system.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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